Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Office of Engineering and Technology's	)	ET Docket No. 17-340
Technological Advisory Council	)	
Spectrum Policy Recommendations	)	

COMMENTS OF T-MOBILE USA, INC.

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T-Mobile USA, Inc. ("T-Mobile")[1] submits these comments in response to the Office of Engineering and Technology ("OET") Public Notice seeking comment on Technological Advisory Council ("TAC PN") recommendations on a set of spectrum management principles.[2] The TAC PN also seeks comment on whether and how these principles could be integrated into FCC spectrum policy. T-Mobile is supportive of the Commission's efforts to better define licensees' responsibilities and add more transparency to the spectrum allocation rulemaking process but recommends a cautious approach towards implementing certain suggestions made within the TAC PN.

I. INTRODUCTION AND SUMMARY

T-Mobile commends OET for seeking comments on these important issues. The TAC PN is particularly timely given ongoing Commission proceedings to identify additional bands for commercial mobile broadband use and to develop appropriate rules for those bands.[3] The TAC

[1] T-Mobile USA, Inc. is a wholly-owned subsidiary of T-Mobile US, Inc., a publicly traded company.

[2] *See* Office of Engineering and Technology Seeks Comment on Technological Advisory Council Spectrum Policy Recommendations, ET Docket No. 17-340, *Public Notice*, DA 17-1165 (rel. Dec 1, 2017) (*Spectrum Policy Recommendations White Paper*).

[3] *See, e.g.*, Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz, GN Docket No. 17-183, Notice of Inquiry, 32 FCC Rcd 6373 (2017) at 1 ("In this Notice of Inquiry, we seek input on potential opportunities

PN recommends nine principles for the Commission's consideration as the basis for a policy statement setting forth spectrum management guidance and principles. T-Mobile is supportive of many of these recommendations and principles and any effort that results in more transparency and certainty to the spectrum allocation rulemaking process.

In considering the ideas proffered in the TAC PN, the Commission must remain mindful that each frequency band has its own unique challenges when considering whether to reallocate spectrum or modify service rules. Each band has its own mix of incumbent users, both within the band and in adjacent bands and the physical properties of each band differs depending on where it falls in the spectrum. As the TAC PN points out, the Commission must evaluate each band on its own merits. In general, as the Commission evolves its approach it should focus on:

1) Providing greater certainty regarding spectrum rights and interference potential. Applied prospectively this will provide greater clarity to licensees as to how equipment and networks, including both transmitters and receivers should be designed and deployed to provide reliable service,

2) Understanding how interference impacts particular systems. For some radio systems, even a relatively small increase in noise can degrade services below acceptable performance metrics, while other systems may be able to tolerate relatively high levels of interference and continue to meet service and mission requirements. In many cases, particularly for satellite and government systems, interference thresholds have been based on a theoretical rise in noise[4] yet it is not clear that operating above those thresholds actually causes harmful interference.

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for additional flexible access—particularly for wireless broadband services—in spectrum bands between 3.7 and 24 GHz (midband spectrum).").

[4] Interference thresholds are often represented as interference-to-noise ratios (I/N) which are mathematically related to specific increases in noise. For example, an I/N of -6 dB is equivalent to a 1 dB rise in noise. *See, e.g.,* NTIA Technical Report "INTERFERENCE PROTECTION CRITERIA - Phase 1 - Compilation from Existing Sources,"

3) Applying realistic interference analysis. Too often worst case assumptions are used in analysis resulting in unrealistic and pessimistic outcomes.

If applying the TAC's nine spectrum management principles to the rulemaking process however, T-Mobile cautions the Commission that their application cannot come at the expense reducing the flexibility licensees currently enjoy to design, build, and manage their networks to deliver the service consumers expect. Furthermore, application of these principles, particularly with respect to interference protection rights, cannot be contingent on requirements for licensees to divulge company sensitive or proprietary information.

T-Mobile supports efforts by the TAC and the Commission to incorporate better and more realistic analysis into the rulemaking process including more quantitative analysis and risk-informed-assessments that move away from considering worst-case situations and considers more realistic modelling T-Mobile also believes that any additional transparency and use of new methods and approaches within the spectrum allocation process should apply equally to federal agencies.

T-Mobile is fully supportive of any Commission initiative that results in more timely interference resolution. Industry spends considerable resources to track down interference and, in the vast majority of cases, is able to resolve issues cooperatively without Commission engagement. The Commission should focus its resources on quickly resolving interference issues that have not been otherwise resolvable. .

NTIA Report 05-432, Oct. 2005; Available at: https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf.

II. THE TAC SPECTRUM MANAGEMENT PRINCIPLES CAN FORM THE BASIS OF AN FCC FRAMEWORK FOR ALLOCATION RULEMAKINGS

The TAC PN recommends that the Commission consider adopting nine spectrum management principles described in the TAC's 2015 *Basic Spectrum Principles White Paper*.[5] These principles cover three broad areas - Interference Realities, Responsibilities of [Radio] Services and Regulatory Requirements and Actions. The TAC PN suggests that adopting these principles could be useful in helping to improve the compatibility of services that operate under [existing or] new spectrum allocations.[6]

T-Mobile has been involved in every major spectrum allocation in the recent past, including, among others, Spectrum Frontiers, creation of the 600 MHz Service, and the various Advanced Wireless Service (AWS) band proceedings.[7] Each of these allocation proceedings had one thing in common; they each took a long time to go from proposed rules to final rules to licenses being issued and services provided to the American public. For example, it took over five years from the Commission proposal to consider the AWS-1 spectrum to an auction to issue licenses.[8] In many cases, much of the delay was caused by debates regarding the various technical limits that should be applied to each service and the interference protection that comes along with those limits. T-Mobile is in favor of guidelines or a framework that could help speed

[5] *See*, December 2015 paper "Basic Principles for Assessing Compatibility of New Spectrum Allocations", https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting121015/Principles-White-Paper-Release-1.1.pdf (*Basic Spectrum Principles White Paper*).

[6] *Spectrum Policy Recommendations White Paper* at 2.

[7] *See, e.g.*, GN Docket No. 14-177 (Use of Spectrum Bands Above 24 GHz For Mobile Radio Services (Spectrum Frontiers)); GN Docket No. 12-268 (Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions); and GN Docket No. 12-354 (Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550- 3650 MHz Band).

[8] The AWS-1 spectrum was proposed for flexible mobile use in December, 2000 and the auction to issue licenses for the band did not commence until August, 2006. *See* Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services including Third Generation Wireless Systems, ET Docket No. 00-258, Notice of Proposed Rulemaking and Order, 16 FCC Rcd 596 (2001). *See also*, Auction 66 Advanced Wireless Services (AWS-1) Fact Sheet, available at http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=66.

the process by setting clear expectations for all interested parties which could avoid much of the back-and-forth technical arguments of past proceedings. The principles laid out by the TAC PN are a good start towards this goal, but the Commission should be judicious in adopting them as hard and fast rules. Instead, the principles can serve as a useful framework for the Commission when developing proposals and final rules to guide the process and inform interested parties as to the limits of what the Commission will consider.

As an initial matter, the TAC principles are not inherently flawed but should not be adopted as a "one size fits all" approach for spectrum management that would be inconsistent with the technical realities associated with the marketplace uses of spectrum. Instead, the Commission could best use the principles as guidance to determine and explain various trade-offs and decision points during the rulemaking process. Under this approach, the principles could be utilized by the Commission and regulated parties to understand the framework for reaching resolution of new and/or modified spectrum allocation decisions.. Each broad section of principles is discussed more fully below.

A. Application of the Spectrum Management Principles Must Provide Appropriate Protection While Not Reducing Licensee Flexibility

The TAC PN states that both transmitters and receivers play a role in whether harmful interference occurs and its severity and that licensees should design their systems to include measures for operating in less than ideal conditions.[9] T-Mobile agrees and notes that the characteristics of both transmitters and receivers must be considered as part of the design and deployment of new mobile network technologies. However, the Commission should not attempt to determine the appropriate performance level for any particular component of a system, but should instead focus on what is a reasonable expectation for interference resiliency of a system

[9] *Spectrum Policy Recommendations White Paper* at 2-3.

as a whole since tradeoffs between transmitter deployment and receiver performance involve potentially costly compromises and should be left to industry. Nonetheless, as detailed more fully below, T-Mobile believes the Commission can provide guidance to potential licensees during the rulemaking process based on the TAC PN's principles, but must do so in a way that continues to allow flexibility for licensees to make the best decisions for their system designs.

Caution is needed in this instance because radio systems are complex and a one size fits all approach cannot cover the various situations that must be accounted for when implementing a new allocation. To its credit, the TAC PN recognizes that a "one policy fits all" approach to developing policies related to inter-service interference is not possible given the disparate requirements of various services.[10] T-Mobile agrees. Clearly, the approach to developing coexistence rules for either co-channel or adjacent channel services must differ based on the nature of the services.

More to the point, T-Mobile has invested billions of dollars to secure exclusive spectrum licenses and build its network to provide customers a widely deployed, highly reliable network and as such believes that any examination of coexistence for new services must be approached from the standpoint of not degrading the user experience. That said, T-Mobile agrees with the TAC PN in its "Interference Realities" principles that licensees should (and in fact do) build margin into their systems to protect against nearby radio services (existing and potential new ones) and to deal with the unpredictable electromagnetic environment.[11] However, the Commission must recognize that carriers already design their networks around various performance parameters accounting for the radiofrequency environment and that specifying any

[10] *Basic Spectrum Principles White Paper* at 4.

[11] *Spectrum Policy Recommendations White Paper* at 2-3.

particular minimum margin will be unmanageable. Carriers are in the best position to determine the optimal designs for their networks, not the Commission.

Moreover, the Commission must recognize that the impact of interference can vary greatly between services and systems. For a commercial broadband provider, even a modest increase in noise will degrade system performance to some degree and reduce customer data speeds. Other types of systems may be able to tolerate increased noise with no noticeable impact until the interference reaches a certain threshold. The key for the Commission is to ensure that there is a clear understanding of the impact of interference on a given system. Too often, particularly for satellite systems and government systems, interference thresholds are based on a theoretical increase in noise that may not result in harmful interference. In many cases, the system operators are unable to describe or quantify the impact operations at or above those interference thresholds have on their systems. Thus, T-Mobile supports the Commission providing clarity around the impact of noise and/or interference on a system, but stops short of endorsing any policy where the Commission would dictate design parameters.

B. Commercial Providers Already Incorporate Best Practices Without A Mandate From The Commission

The TAC PN's principles for "Responsibilities of [Radio] Services," are premised on recognizing the roles of both transmitters and receivers in mitigating interference as well as the need to employ interference mitigation techniques at all layers of the network. T-Mobile, as well as all other network operators, already take these measures into consideration when designing and building networks. Commercial mobile broadband spectrum is a valuable resource with strong market forces and competition that drive use of spectrally efficient and robust state of the art technologies. First, T-Mobile and other commercial mobile service providers strive to provide the best transmitters and receivers possible within the practical constraint that consumer

equipment and base stations must be economically viable. In fact, industry standards often impose more stringent standards than the Commission's rules. For example, with respect to transmitters, the Commission's standard out-of-band emission limit for commercial services is -13 dBm, but the 3GPP standards generally impose more stringent requirements.[12] And the industry already has its own exacting standards for receivers which commercial mobile service equipment often exceeds.[13] Finally, while the TAC PN recommends that systems employ techniques such as using directional antennas, employing multiple-in/multiple-out ("MIMO") techniques, using power control and adaptive modulation techniques, among others to mitigate the effects of interference,[14] these techniques are already standard within the commercial mobile industry and used in different areas to varying degrees depending on the environment.[15]

T-Mobile sees no need for the Commission to dictate what is already considered best practices and implemented industry-wide for proper network design for commercial mobile networks. Thus, T-Mobile agrees with the TAC PN that these are good principles to keep in mind as networks are designed and developed. However, the Commission should not mandate use of these techniques or any particular technique or technology and instead allow carriers to

[12] For example, 47 C.F.R. § 27.53(h) generally only requires only that emissions be attenuated to -13 dBm anywhere outside the licensees frequency block for the AWS bands while the 3GPP standards require for a 5 megahertz channel bandwidth, an emission limit of -15 dBm in the first megahertz adjacent to the licensees frequency block, -10 dBm over the next 4 megahertz, and then dropping down to -13 dBm and -25 dBm between 5 and 6 megahertz and 6 to 10 megahertz outside the licensees frequency block, respectively. *See* 3GPP TS 36.521-1 version 13.1.0 Release 13, Section 6.6.2.1.3 Minimum Conformance Requirements.

[13] *See, e.g.*, CTIA Comments in ET Docket No. 13-101, "Office of Engineering and Technology Invites Comments on Technological Advisory Council (TAC) White Paper and Recommendations for Improving Receiver Performance" at 3 ("The wireless industry …deploys some of the most interference-resistant receivers in the world. Utilization of high-performing receivers has allowed the wireless industry to efficiently and effectively reuse scarce spectrum resources to deliver high speed data and voice services to consumers.")

[14] *Basic Spectrum Principles White Paper* at 15-16.

[15] *See, e.g.*, 5G Americas "Executive Summary, Inside 3GPP Release 13: Understanding the Standards for LTE-Advanced Enhancements, 2016 Update" (Stating at 1 that LTE-Advanced, Rel-13 supports Active Antenna Systems (AAS), including beamforming and Multi-Input Multi-Output (MIMO), among other features.) Available at: http://www.5gamericas.org/files/4314/7700/6698/Inside_3GPP_Release_13_Understanding_the_Standards_for_LTE_Advanced_Enhancements_Final.pdf.

continue to have flexibility to innovate and design their networks using the most advanced techniques available.

In contrast, it cannot be assumed that services in which spectrum use is not driven by competitive market-based forces similarly make routine use of and upgrade to state-of-the-art technology. The Commission should take that into account and implement interference protection criteria on a case-by-case basis. In such cases it may be appropriate to limit protection as a way to drive deployment of more robust technologies without mandating any particular technology.

C. The FCC Must Not Require Disclosure Of Proprietary Information In Exchange For Interference Protection

While T-Mobile generally supports the TAC PN's first six principles as they provide a basis for good spectrum management practice, the principles expressed in the third area, "Regulatory Requirements and Actions" must be applied with additional care.

In this section, the TAC's Principle #7 states:

> "Services under FCC jurisdiction are expected to disclose the relevant standards, guidelines and operating characteristics of their systems to the Commission if they expect protection from harmful interference."[16]

As an initial matter, T-Mobile notes that interference protection has a well-established foundation both within the FCC rules and internationally within the ITU Radio Regulations. For example, secondary services must protect primary services and licensees receive international protections from interference based on their priority within the allocation table.[17] And within each allocation category, stations granted licenses first in-time are generally protected from

[16] *Spectrum Policy Recommendations White Paper* at 2.

[17] *See* 47 C.F.R. §§ 2.104(d) and 2.105(c) and International Telecommunications Union Radio Regulations, Article 5, Section 5.23.

harmful interference from later licensed stations unless the rules specify otherwise.[18] The TAC PN's suggested approach would undermine this long standing and well-established precedent. Interference protection cannot be contingent on a requirement for service providers to disclose operating characteristics, many of which are proprietary and relevant to internal confidential business and competition information.

Moreover, what the TAC PN suggests could lead to different levels of protection provided to similarly situated licensees based on equipment choice or operating protocol – a straightforward violation of the Commission's statutory requirement to treat such licensees similarly.[19] Licensees must be able to make choices based on a clear set of rules which lay out service-wide levels of protection allowing them to implement their business plans as they see fit. Any imposition of licensee, equipment, or protocol specific protection requirements could have the adverse effect of preventing licensees from evolving technology to increase efficiency or providing new services if such efforts result in a change in protection levels. Commercial carriers cannot plan and invest in network infrastructure based on a moving, unknown target. T-Mobile urges the Commission to continue its current policy to adopt rules on a service-by-service basis and impose them in a fair and equitable way for all licensees.

TAC Principle #8 raises similar concerns. That principle states:

> "The Commission may apply interference limits to quantify rights of protection from harmful interference."[20]

[18] *See, e.g.*, 47 C.F.R. § 101.147(z) which grants first-come, first-served protection to microwave links operating the 71,000-76,000 MHz; 81,000-86,000 MHz; 92,000-94,000 MHz; and 94,100-95,000 MHz bands.

[19] *See, e.g.*, Implementation of Sections 3(n) and 332 of the Communications Act; Regulatory Treatment of Mobile Services, GN Docket No. 93-252, Second Report and Order, 9 FCC Rcd 1411 (1994), para 2 ("This Order reflects the Commission's efforts to implement the congressional intent of creating regulatory symmetry among similar mobile services.").

[20] *Spectrum Policy Recommendations White Paper* at 3.

This principle raises several significant issues: (1) a need to ensure that any policies adopted are implemented equitably to all regulated parties; (2) an imperative to apply technical and service rules in advance of licensing; and (3) a requirement to apply new interference limits prospectively. Initially, any Commission effort to apply interference limits to quantify protection rights must be applied prospectively and not retroactively. According to Administrative Procedures Act requirements, any change to the rules is required to be done through public rulemaking.[21] Therefore, any licensee will be fully aware of any limits or protection rights placed upon a spectrum license prior to grant.[22]

Applied prospectively, T-Mobile agrees that interference limits can be a useful tool that can provide greater certainty for licensees, as well as facilitate new uses of spectrum, both co-channel and adjacent- channel by foreclosing potentially years of debate over required interference protection during spectrum reallocation proceedings.

TAC Principle #9 broaches the idea of using quantitative analysis in making allocation decisions. This principle states:

> "A quantitative analysis of interactions between services shall be required before the Commission can make decisions regarding levels of protection."[23]

T-Mobile does not object to the Commission conducting or using quantitative analysis to make decisions. To the contrary, T-Mobile encourages the Commission to use the most up-to-date data and methodologies available to assess potential interference impacts between services. Conducting such analyses at the onset of a proceeding would provide a transparent window into

[21] *See* 5 U.S.C. § 553.

[22] It should be noted that applying specific protection rights is different than using a reasonable basis for determining harmful interference to a service. While what constitutes harmful interference may differ from service to service, the Commission must necessarily make such a determination for services in which an interference threshold has not been established.

[23] *Spectrum Policy Recommendations White Paper* at 3.

the realm of reasonable protection levels among services. The process for generating agreement among parties, however, should be carefully considered.

The TAC PN states that, "[d]ifferences between models and their associated inputs used by the FCC and by diverse stakeholders may lead to widely different interference results and produce disputes leading to costly delays."[24] As previously stated, this issue lies at the heart of the delay that occurs during allocation rulemaking proceedings. The Commission should provide clear guidance to the industry at the onset of a proceeding on its view of what would and would not be acceptable in the way of analysis. For example, the Commission could suggest a propagation model or provide guidance which discourages worst case analysis. More significantly, this may be another area where the Commission could convene a multi-stakeholder group to work towards industry consensus for analysis purposes for determining the interference protection parameters for new allocation proceedings. However, should the Commission consider such action, it cannot come at the cost of even more delay if certain stakeholders only see the process as a way to foment even more delay. In lieu of that, the Commission should continue its current practice of relying on industry analyses subject to public comment and replies along with any of its own analysis to reach a decision. Whichever way the Commission decides to proceed in this regard the process must be transparent. Finally, it is vitally important that the Commission encourage NTIA to provide full details of any analysis it conducts for allocations involving federal shared spectrum allocations.

[24] *Basic Spectrum Principles White Paper* at 23.

III. RISK-INFORMED-INTERFERENCE-ASSESSMENT (RIIA)

The TAC PN recommends that the Commission more broadly use risk-informed interference assessment and statistical service rules. The TAC PN asserts that the Commission, in balancing the interests of incumbents, new entrants, and the public, has generally used qualitative as opposed to quantitative analysis to make decisions.[25] By modifying its approach, the TAC PN states that the Commission should consider the likelihood-consequence combinations for multiple interference hazard scenarios, and complement a worst case analysis that considers the single scenario with the most severe consequence, regardless of its likelihood.[26] To support, its position, the TAC PN references the Nuclear Regulatory Commission's ("NRC") effort to adopt such measures and recommends that the Commission use quantitative risk assessment in its own analyses and publish the results.[27]

T-Mobile agrees that such analysis could improve and streamline the spectrum allocation process, but again is concerned that developing models and conducting these analyses may fall short of the goal and serve only to create more debate over choice of inputs, propagation models, etc., and prolong resolution and decision-making. To manage this process effectively, the Commission should set expectations for what it considers reasonable limits, *i.e.*, moving away from worst-case analysis towards an approach based on more realistic operating scenarios. For example, the Commission could state at the start of a proceeding that it will not consider technical analyses based on assumptions that push the limits of reasonableness, such as (but not limited to): (1) using assumptions that receivers always operate at the limits of their sensitivity level with very little margin built in; (2) asserting that OOBE is always at its highest levels

[25] *Spectrum Policy Recommendations White Paper* at 5.

[26] *Id*.

[27] *Id*.

anywhere outside the desired band; or (3) arguing that potential interfering signals are always operating at full power on immediately adjacent channels with no alternatives available. Providing even modest guidance could speed the spectrum allocation rulemaking process by eliminating superfluous studies that need not be seriously considered when drawing conclusions and finalizing rules for new services. It would also ensure that technical analyses provided in the record are based upon fundamentally sound principles that help to resolve allocation decisions instead of prolonging them.

Finally, T-Mobile suggests that it would be beneficial to streamline the spectrum allocation process to include federal operations. T-Mobile encourages the Commission to engage with NTIA and the federal agencies to refine and streamline spectrum analysis to better ensure reasonable and accurate outcomes. As more and more spectrum is being reallocated or shared between federal and non-federal entities, it is critical that private sector service providers are not arbitrarily handicapped by unreasonable protection criteria. Instead there should be a clear understanding of the impact of interference to a Federal system to ensure that analysis is based on reasonable criteria. favored by federal entities especially when, in many cases, such entities rely on similar systems and technology.

IV. CONCLUSION

T-Mobile appreciates the opportunity to provide comments on potential improvements to the spectrum management process. The Commission should act cautiously and consider whether any of the TAC PN's recommendations needs to be recognized in a Commission policy statement or simply form the framework for developing frequency band specific proposals and guiding interested parties, as necessary, through each proceeding. In any case, licensees must retain flexibility to manage their networks to ensure customer service and economic viability.

Respectfully submitted,

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